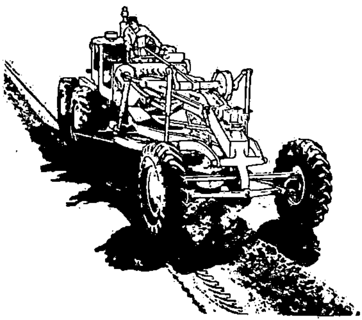
INSPECTOR'S HANDBOOK

SUBBASE CONSTRUCTION



IOWA STATE HIGHWAY COMMISSION

AMES, IOWA

1969

SUBBASE CONSTRUCTION

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Jerry Rodibaugh

INTRODUCTION

This handbook is an inspector's aid. It was written by two inspectors to bring together all of the most-often-needed information involved in their work.

Much care has been taken to detail each phase of construction, with particular attention to the requirements and limitations of specifications. All applicable specification interpretations in Instructions to Resident Engineers have been included.

The beginning inspector should look to the handbook as a reference for standards of good practice. The Standard Specifications and Special Provisions should not, however, be overlooked as the basic sources of information on requirements and restrictions concerning workmanship and materials.

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SUBBASE CONSTRUCTION

Definition

A subbase lies between the subgrade and the base. It has greater stability than the subgrade, and is particularly beneficial with a subgrade of inherently low stability subjected to excessive moisture.

Types

Four types of subbases are used in Iowa:

1) soil aggregate subbase
2) granular subbase
3) soil lime subbase
4) soil cement subbase

When no special subbase is designed into the plans, the roadbed is constructed with a natural subgrade according to Standard Specifications, sections 2109.01 through 2109.04.

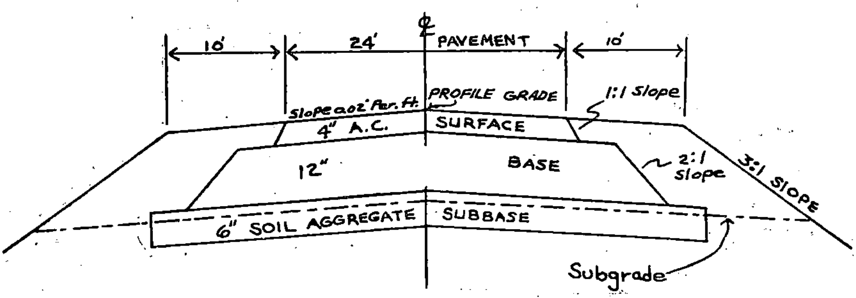

Figure 1 – Typical Section

INSPECTION

Plans, Proposals, and Specifications

Inspectors must be furnished a set of construction plans, proposals, and specifications. Plans indicate length, width, and depth of various components, and provide information about quantities and procedures. The title sheet designates the applicable standard specification book by date.

The inspector should familiarize himself with plans and specifications, checking contract items and quantities to verify their accuracy. The proposal – or contract – designates applicable special provisions and other supplemental specifications by number and date.

The resident or county engineer should issue all of these documents to the chief inspector, grade inspector, plant inspector, and other key inspectors.

The individual inspector should have these copies with him in the field for ready reference.

Preconstruction Details

Before any construction work is started, the resident or county engineer and/or designated inspectors should converse with the contractor to ensure that specifications, limitations, materials, and equipment are fully agreed upon.

The inspector should check and verify that the contractor has enough signs and barricades in place, or at least available when needed.

There should be enough checkers and inspectors to examine the various phases of construction without undue delay to the contractor.

STAKING

Purpose

In county highway construction, a line of stakes is usually set at a convenient distance from the centerline of the highway. The location usually falls on the foreslope or another area undisturbed by construction operations. The stakes are used only for alignment.

Specifications require that the elevation of the roadbed surface on primary and interstate highway construction projects be indicated by grade stakes. The surface of the subbase and of some types of base course must also be indicated by grade stakes. The surface of the various layers should, therefore, be constructed to conform to the desired elevation indicated (within .05 foot variation) by grade stakes.

Techniques

Because uniform methods and procedures throughout the state are considered desirable, survey parties are urged to use the following staking techniques:

1) Drive reference hubs at 50-foot intervals on straight grades, and at 25-foot intervals for transitions, horizontal curves, and sharp vertical curves. The hubs should be driven flush with the ground on each side of the roadbed, and offset far enough to clear construction operations. The usual location is just over the edge of the foreslope. The elevation of the corrected roadbed at a designated location should be marked at each grade stake.
2) When determining the roadbed elevation, it is considered advisable to hold the moving of earth to a minimum. This can usually be done if the elevations are lowered to permit the cut quantities to slightly exceed the fill.
3) The resident construction engineer is responsible for setting and marking stakes to indicate alignment and the profile grade desired. He assigns a survey party to this task.
4) The contractor is responsible for actual construction work. He must provide all necessary equipment and personnel for each stage of work. All blue-tops or stakes deemed necessary are set by the contractor; he is responsible for their accuracy.

SUBGRADE CORRECTION

Application

On county highways, the cross-section is checked with an accurate template extending at least half way across the width of the subgrade or subbase. Deviations in excess of specifications must be corrected. The roadbed profile should be remedied to remove dips and humps. When correction is completed, the roadbed must have a good riding surface.

On primary and interstate projects, any loose granular materials present on the roadbed should be bladed into a windrow and stored on the shoulder area. Granular material incorporated into roadbed earth should not receive special attention; it should be treated as earth during roadbed correction operations. It is usually necessary to waste some of the earth during correction, for elevations are established to require no borrow.

It is also desirable that earth should not have to be drifted great distances. The subgrade must be corrected to the required profile and cross section. Moved material should be consolidated to provide a firm foundation for the next layer.

When correction of the roadbed involves filling three inches or more of depth, specifications require that the material be thoroughly moistened and compacted to remain in place under construction traffic.

Profile and Cross–Section Requirements

The profile and cross–section requirements for subgrade construction correction are as follows:

1) Elevation of the subgrade surface must be indicated by grade stakes. The surface of the subgrade should be corrected (in both profile and cross-section) to conform to current specifications for desired elevation from grade stakes.
2) At railroads, pavements, bridges, and other similar structures, the subgrade should be excavated to permit construction of the full thickness of base and surface courses at the proper elevation. The excavation should then be tapered to meet the normal elevation of the subgrade.

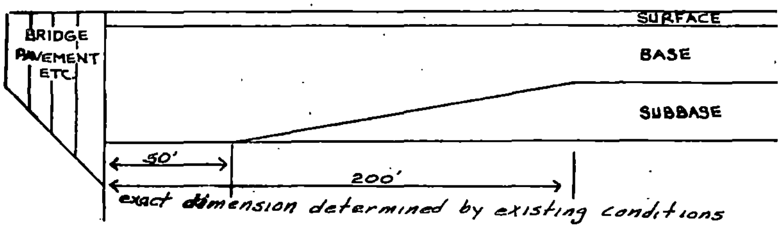

Figure 2 – Typical method of flexible base construction with junction at railroads, bridges, existing pavements, and other similar structures.

3) Before construction of subbase, loose granular material stored on the shoulder should be spread uniformly on the surface of the subgrade.

INSPECTING DIFFERENT TYPES OF ROLLERS USED IN SUBBASE CONSTRUCTION

Tamping Rollers

The inspector measures (in square inches) the area at the end of the feet on a single row of feet parallel to the axis of the drum. This figure is multiplied by the pounds-per-square-inch required by current specifications to find the total weight of the roller. The weight is verified by weighing on approved scales.

Self–Propelled, Steel–Tired Rollers

These rollers are of a weight class specified in construction specifications. The inspector checks the diameter of the compaction roller to see that it complies with current specifications. He measures the width of the roller in inches and multiplies this figure by the required pounds-per-square-inch indicated in current specifications. The product is the required gross weight of the compaction roller. This weight must be verified by weighing on approved scales. In weighing the roller, both compaction and guide wheels should be at the same elevation; but, during weighing, only the compaction wheel rests on the scales.

Self-Propelled and Pull-Type Pneumatic Tire Rollers

To determine the weight of this type of roller, the inspector first measures the width in inches of the widest axle, beginning with the outside tire and measuring the total distance to the outside tire of the opposite side. He multiplies this figure by the pounds-per-square-inch required in current specifications. The product is the required gross weight of the roller. This weight should be verified by weighing on approved scales. Pneumatic-tired rollers are operated with a tire inflation pressure recommended in specifications. Spaces between the wheels are compensated for through offsetting the tires on the two axles.

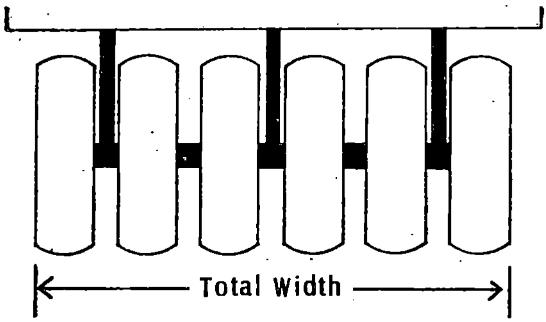

Figure 3 – Pneumatic–Tired Roller

SPREAD RATES AND PLAN QUANTITIES

Spread Chart

Construction plans indicate the desired rate-of-application of subbase material. A simple and accurate spread chart should be made for spread inspectors to use. It should specify the distance each pound of material must be spread to produce the proper thickness and width. The project inspector should also check the spread plan for accuracy.

thousands of pounds

distance (in feet) material must be spread for proper thickness and width

hundreds of pounds

	-0	100	200	300	400	500	600	700	800	900
15,000	25.0	25.2	25.3	25.5	25.7	25.8	26.0	26.2	26.3	26.5
16,000	26.7	26.8	27.0	27.2	27.3	27.5	27.7	27.8	28.0	28.2
17,000	28.3	28.5	28.6	28.8	29.0	29.2	29.3	29.5	29.7	29.8
18,000	30.0	30.2	30.3	30.5	30.7	30.8	31.0	31.2	31.3	31.5
19,000	31.7	31.8	32.0	32.2	32.3	32.5	32.7	32.8	33.0	33.2
20,000	33.3	33.5	33.7	33.8	34.0	34.2	34.3	34.5	34.7	34.8
21,000	35.0	35.2	35.3	35.5	35.7	35.8	36.0	36.2	36.3	36.5
22,000	36.7	36.8	37.0	37.2	37.3	37.5	37.7	37.8	38.0	38.2
23,000	38.3	38.5	38.7	38.8	39.0	39.2	39.3	39.5	39.7	39.8
24,000	40.0	40.2	40.3	40.5	40.7	40.8	41.0	41.2	41.3	41.5

Figure 4 – A Typical Spread Chart for 30 ton/sta.
.16667 ft./100 lbs. – 600 lbs./ft.

Using the chart, a net load of 18,600 pounds would spread 31.0 feet. The spread inspector should verify this material-dumping distance. To check yield, he multiplies the number of stas., (.31) by the application rate of 30 tons per sta. (.31 x 30 – 9.3 tons, or 18,000 lbs.).

The scale inspector should:

1) have a copy of the spread chart.
2) put the correct spread for the corresponding net load on the scale ticket.
3) see that other project information, such as project number, county, material, and correct net weight is the scale ticket.
4) sign or initial all tickets leaving the scales with approved material.

The spread inspector should:

1) sign or initial each weight ticket as the truck is dumped.
2) check the spreading of material in the proper locations and amounts.

3) keep the original copy of all tickets for the project records and return other copies to the driver.
4) make sure that each ticket is for his project, and has been signed or initialed by the scale inspector.

BEST CO.
WHERE, IOWA
NO. F-1234

TRUCK NO. 12 DATE 6-20 19 68
SOLD TO Iowa State Highway Comm.
PROJECT NO. F-1-2(3)-20 COUNTY Lee

MATERIAL Subbase Material
GROSS 29,200 LbS. spread 31.0 ft
TARE 10,600 LbS.
NET 18,600 LbS.
WEIGHER Lee CHECKER J&R INSP.
TRUCK DRIVER George
RECEIVED W.J.S. INSP.

Figure 5 – Scale Ticket

Granular Subbases

The range (in types) of material acceptable for granular subbases is quite broad, which may result in a corresponding variance in unit weights. Hence, to construct a subbase of the designated thickness, it is necessary to distribute materials on the road according to actual weight.

When the source of material for a granular subbase has been approved by the Materials Department, the resident construction engineer should ascertain the wet weight of the material. Then he should arrange for distribution of a test section on the basis of actual weight and designed thickness of base.

MOISTURE CONTROL

Soil Aggregate Subbase

Moisture content of the soil aggregate mixture is approved upon visual inspection. The subbase is uniformly wetted to contain the amount of water needed to produce required density and stability at the time it is spread and compacted with the field compaction process.

Granular Subbase

Unless otherwise stated, material for granular subbases should be pre-wetted with equipment used for pre-wetting aggregate and aggregate mixtures (other than soil cement or portland cement concrete). When the material is delivered to the subgrade, water is uniformly distributed to wet all particles. The amount of water must conform to current specifications for the field optimum to produce required density and stability. Until compaction of the subbase has been completed, moisture content must be maintained in the aggregate by frequent applications of water.

Soil Lime Subbase and Soil Cement Subbase

After soil and lime (or cement) have been uniformly combined, water should be uniformly applied and mixed with the soil lime (or cement) mixture. Moisture content at the time of compaction must conform to current specifications. Inspectors should determine and document moisture content prior to compaction.

During compaction, additional wetting and shaping necessary to produce a finished subbase (of the specified cross section and profile) should be performed.

PULVERIZATION CONTROL

Soil Aggregate Subbase

Road surface material and added granular material must be mixed thoroughly enough to prevent seams or streaks of separate materials obvious to visual inspection. All such materials should be pulverized so there are no soil particles larger than two inches. Inspectors should ensure that pulverization is satisfactory by shoveling a section from the windrow immediately before spreading for compaction.

Granular Subbase

No pulverizing is required.

Soil Lime Subbase and Soil Cement Subbase

The mixture should be pulverized according to current specifications. At the time of compaction, the material is checked for pulverization by sampling approximately 50 pounds from representative areas. This is then split down to approximately 22 pounds, and shaken through the specified sieves.

SUBBASE TESTING

Modified Proctor Test for the Modified Moisture/Density Relationship of Soils

SCOPE:

This test is used to determine the relationship between the moisture content and density of either soils or flexible base materials compacted according to a standard procedure, A.A.S.H.O. T–180–57, Method C.

Apparatus:

1) Metal mold, tapered from 4 inches to 4.975 inches in diameter and 4.50 inches in height, with base plate and collar. A counterbalance equal to the weight of the mold is useful.
2) Scale, capable of weighing at least 5000 grams, sensitive to 0.5 gram.
3) Compaction device, consisting of a 10 pound hammer and rod enclosed in a guide tube providing an 18 inch hammer drop.
4) Straightedge of steel, 9 inches long, with one leveled cutting edge.

5) Drying equipment, preferably an oven capable of maintaining a temperature of 230° F., or a gas hot plate.
6) Mixing equipment. A stainless steel (dish) pan, long handled spoon, rubber or rawhide mallet, putty knife, graduated cylinder, and tared weighing scoop.
7) Sample extruder.
8) Tared moisture pans.

Calibration:

The 18 inch hammer fall will not change. However, the tube interior and surface of hammer must be kept clean at all times to ensure free fall. The steel mold need not be calibrated, for it will retain its volume of 1/30 cubic foot unless damaged or machined.

Sample Preparation:

The field sample is quartered to a representative sample of about 5000 grams. The sample is spread out and allowed to dry to a moisture content at least 5% below the estimated optimum moisture content. This sample is screened over a ¾" sieve and the aggregate retained is replaced with an equal weight of #4 to ¾" material taken from the original field sample.

Test Procedure:

1) The prepared sample is pulverized so that 90% of all material (except aggregate) will pass the #4 sieve. The sample is placed in the mixing pan, and water is sprinkled on it while stirring. After thorough mixing, the sample is ready for test when a handful of soil squeezed tightly in the palm

of the hand will barely hold together when pinched between the fingers.

2) An amount of dampened sample that will yield slightly more than 1/5 the height of the mold after compaction is weighed and loosely placed in the assembled mold. The mold is put on a solid surface (such as a concrete floor) for compaction.

3) The hammer and guide tube assembly are placed lightly on the top of the guide stop and allowed to drop freely. Twenty-five such blows are distributed uniformly over the layer. Care should be taken in this operation to not allow the tube to be lifted from the sample, nor to restrict the free fall of the hammer. A measurement is made to determine if a slight excess over the amount needed to fill 1/5 of the mold is present.

4) The weight of the soil taken for the second layer is adjusted as needed to give the desired height, placed in the mold, and compacted the same as the first layer. This process is repeated for five layers. During the entire operation, sample material should not be allowed to build up on the bottom of hammer or on the inside of the guide tube.

5) The mold is then removed to a table, the collar taken off with a twisting motion, and the excess sample removed in thin layers by cutting with the straightedge. If the soil projects more than 3/8 inch above the mold, or if the mold is not completely filled, the compactive effort was incorrect. The compacted specimen should then be extruded, pulverized, and returned to the mixing pan.

After remixing, the weights for each layer are adjusted accordingly and recompacted by the same procedure. Small aggregates pulled from the surface are replaced with finer hand-tamped material. Large, well-embedded aggregates are left in place, and the top finished to arrive at a surface that will average level full.

6) The mold and contained specimen are detached from the base plate and weighed using the mold counter-balance. This weight is recorded. The sample is extruded, and a vertical pie-shaped moisture sample (approximately 500 gram) is cut from the compacted specimen. This pie-shaped moisture sample is weighed in a tared pan, the weight and pan number recorded, and dried to give a dry weight and a moisture loss from which the percent of moisture can be calculated. The remaining portion of the specimen is pulverized and returned to the mixing pan.
7) Water—not to exceed 2% of the remaining sample weight—is sprinkled in with constant mixing until uniformity is obtained. Compaction and moisture determination for this moisture content is the same as the first.
8) The procedure of adding water, compacting a specimen, and taking a moisture sample is repeated with increasing moisture contents until a compacted weight is reached which is less than the preceding one. This signifies that the resultant moisture density curve will be past the peak or optimum.

Calculations:

$$\% \text{ Moisture} = \frac{\text{Wt. of moisture loss (100)}}{\text{(Dry Soil + pan) − (pan)}}$$

Example: $$\frac{500 - 461}{461 - 149}(100) = 12.5\%$$

Compacted Dry Weight $$= \frac{\text{(Net Wt. compacted soil) (30)}}{\text{(\% Moisture + 100) (453.6)}}(100)$$

Example: $$\frac{(2913)\,(30)}{(12.5 + 100)\,(453.6)}(100)$$

$$= 118.3 \text{ lb/cu. ft.}$$

2013 = Net wt. (in grams) of soil compacted in mold.

30 = Conversion Factor required since the mold volume is 1/30 of a cubic foot. The answer must be expressed in pounds per cubic foot.

453.6 = Number of grams per pound.

Moisture/Density Relationship

The preceding calculations are made for each compacted specimen.

Using the results, points are plotted with densities (dry weight per cubic foot) as ordinates (vertical axis) and percent of moisture as abscissas (horizontal axis). The resulting points are used to draw a smooth curve. The peak of this curve is the percent-of-moisture which gives maximum density, or, it is the optimum moisture for the Modified Proctor density (the density at this peak).

Standard Proctor Test for the Moisture/Density Relationship of Soils

SCOPE:

This test is used to determine the relation between the moisture content and density of soils or flexible base materials compacted according to a standard procedure, A.A.S. H.O. T–99–57, Method C.

Apparatus:

1) Cylindrical brass mold, 4 inches in diameter and 4.584 inches high, with a capacity of 1/30 cubic foot, a base plate, and a collar. A counterbalance equal to the weight of the mold is useful.
2) Scale, capable of weighing at least 5000 grams, and sensitive to 0.5 gram.
3) Compaction device, consisting of a 5.5 pound hammer inside a cage of 4 metal rods, with the capability of delivering a 12 inch fall of the hammer to each of three layers of soil. The device should be bolted to a concrete pedestal of at least 200 pounds or secured to an equally rigid base.
4) Straightedge of steel, 9 inches long, with one beveled cutting edge.
5) Drying equipment, preferably an oven capable of maintaining a temperature of 230 degrees F., or a gas hot plate.
6) Mixing equipment. A stainless steel mixing (dish) pan, long handled spoon, rubber or rawhide mallet, putty knife, graduated cylinder, and tared weighing scoop.
7) Sample extruder, lever or hydraulic type.
8) Tared moisture pans.

Calibration:

1) The height of hammer fall must be checked periodically. With the base plate in

position and the hammer stop in the bottom indent, the distance between the base plate and the bottom of the hammer should be adjusted to 13.53 inches. The nuts holding the cage to the frame must be well tightened. The hammer should fall freely, and the cage should be vertical.

2) The volume of the base mold should be calibrated by water content at Ames Laboratory at least once a year. Field checks can be made by measurement with a 0.01 inch steel rule and appropriate calculations.

Sample Preparation:

1) The field sample is quartered to a representative sample of about 5000 grams. The sample is spread out and allowed to dry to a moisture content at least 5% below the estimated optimum moisture content.
2) This sample is screened over a ¾" sieve, and the retained aggregate is replaced with an equal weight of #4 to ¾" material taken from the original field sample.

Test Procedure:

1) This prepared sample is pulverized so 90% of all material except aggregate will will pass the #4 sieve. The sample is placed in the mixing pan and water sprinkled on the sample while stirring. The sample is ready for test when (after thorough mixing) a handful of soil squeezed tightly in the palm will barely hold together when pinched between the fingers.

2) An amount of the dampened sample which, after compaction, yields 0.1 inch more than 1/3 the height of the mold is weighed in a tared scoop and loosely placed in the assembled mold. The mold is placed under the hammer, with the depression in the bottom of mold base plate over the projection of the base. The hammer stop is put to the lowest indent and the hammer is raised with a pulling, flipping motion, so that it will hit the stop firmly and then be allowed to fall freely with no restraint from the chain. Twenty-five such blows are delivered, with 1/6 turn of the mold and base between each blow.
3) Measurement is then made to determine if a slight excess of sample over that needed to fill 1/3 of the mold is present. The weight of soil taken for the second layer is adjusted as needed to give the desired height and placed in the mold. The hammer stop is raised to the second indent, and the second layer is compacted in the same manner as the first layer. This process is repeated for a third layer with the hammer stop placed in the top indent. During the entire operation, the sample is not permitted to accumulate on the bottom of the hammer or on the cage rods.
4) The mold is then removed to a table, the collar taken off with a twisting motion, and the excess sample removed in thin layers by cutting with the straightedge. If the soil projects more than 3/8 inch above the mold, or if the mold is not completely filled, the com-

pactive effort is incorrect. The compacted specimen is then extruded, pulverized, and returned to the mixing pan. After remixing, the weights for each layer are adjusted accordingly and recompacted by the same procedure. Small aggregates pulled from the surface are replaced with finer hand-tamped material. Large, well embedded aggregates are left in place, and the top finished to attain a surface will average level full.

5) The mold and contained specimen are detached from the base plate and weighed, using the mold counterbalance. The weight is recorded, the sample extruded, and a vertical pie-shaped moisture sample (approximately 500 gram) cut from the compacted specimen.
6) The pie-shaped moisture sample is weighed in a tared pan and the weight and pan number recorded. It is then dried, giving a dry weight and a moisture loss from which the percent of moisture can be calculated. The remaining portion of the specimen is pulverized and returned to the mixing pan.
7) Water, not exceeding 2% of the remaining sample weight, is sprinkled in with constant mixing until uniformity is obtained. Compaction and moisture determination for this moisture content are the same as the first. The procedure of adding water, compacting a specimen, and taking a moisture sample is repeated with increasing moisture contents until a compacted weight is attained which is less than the preceding one. This signifies that the resultant

moisture density curve will be past the peak or optimum.

Calculations:

$$\% \text{ Moisture} = \frac{\text{Wt. of Moisture Loss}}{(\text{Dry Soil} + \text{Pan}) - (\text{Pan})} (100)$$

$$\text{Example:} = \frac{500 - 446}{446 - 147} (100) = 18.1\%$$

$$\text{Compacted Dry Wt.} = \frac{\text{Net Wt. compacted soil } (30)}{(\% \text{ moisture} + 100)(453.6)} (100)$$

$$\text{Example:} = \frac{(1873)(30)}{(18.1 + 100)(453.6)} (100)$$

$$= 104.9 \text{ lb/cu.ft.}$$

1873 = Net wt. in grams of soil compacted in mold.

30 = Conversion Factor required since the mold volume is 1/30 of a cubic foot. It is required to express the answer in pounds per cubic foot.

453.6 = Number of grams per pound.

Moisture/Density Relationship

1) The above calculations are made for each compacted specimen.
2) Using these results, points are plotted with densities (dry weight per cubic foot) as ordinates (vertical axis) and percent of moisture as abscissas (horizontal axis).

3) The resulting points are used to draw a smooth curve. The peak of this curve is the percent of moisture which gives maximum density, or, it is the optimum moisture for the Proctor Density, which is the density at this peak.

Item No.	Determination	1	2	3	4	5	Method
1	Wet Wt. of Specimens	1982	2119	2194	2188	2149	Grams Weighed
	Pan Number	6	8	5	1	2	
2	Wt. of Pan	150	146.5	148.0	151.0	147.5	Grams Weighed
3	Wet Wt.Pan and Sample	800.0	800.0	800.0	800.0	800.0	Grams Weighed
4	Dry Wt.Pan and Sample	768.5	758.5	750.5	742.5	734.5	Grams Weighed
5	Dry Wt. Sample	618.5	612.0	602.5	591.5	587.0	Grams Diff. 4–2
6	Moisture Loss	31.5	41.5	49.5	57.5	65.5	Grams Diff. 3–4
7	% Moisture	5.09	6.78	8.21	9.72	11.16	(6 ÷ 5) x 100
8	Calc.Dry Weight	1885	1984	2028	1994	1933	Line 1 ÷ (1 + 7 Decimal)
9	Dry Wt.Lb. Cu. Ft.	124.6	131.1	134.0	131.7	127.7	$8 \times \frac{(30)}{454}$

Figure 6 – Example. Line 8 is the calculated dry weight

of material in the compacted specimen. It is obtained by dividing the wet weight in Line 1 by 1 plus the percentage of moisture expressed as a decimal.
Line 9 Dry Weight is computed by dividing the calculated dry weight (Line 8) by 454 (grams per pound) and multiplying by 30, because the volume of a specimen is 1/30 of a cubic foot.

TABLE FOR MOISTURE PERCENTAGES
(Original Wet Wt. = 500 Grams)
(Percentages read direct from dry wt.)

Dry Wt.	0	1	2	3	4	5	6	7	8	9
480	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.2
470	6.4	6.2	5.9	5.7	5.5	5.3	5.0	4.8	4.6	4.4
460	8.7	8.5	8.2	8.0	7.8	7.5	7.3	7.1	6.8	6.6
450	11.1	10.9	10.6	10.4	10.1	9.9	9.6	9.4	9.2	8.9
440	13.6	13.4	13.1	12.9	12.6	12.4	12.1	11.9	11.6	11.4
430	16.3	16.0	15.7	15.5	15.2	14.9	14.7	14.4	14.2	13.9
420	19.0	18.8	18.5	18.2	17.9	17.6	17.4	17.1	16.8	16.6
410	22.0	21.7	21.4	21.1	20.8	20.5	20.2	19.9	19.6	19.3
400	25.0	24.7	24.4	24.1	23.8	23.5	23.2	22.9	22.5	22.2
390	28.2	27.9	27.6	27.2	26.9	26.6	26.3	25.9	25.6	25.3
380	31.6	31.2	30.9	30.5	30.2	29.9	29.5	29.2	28.9	28.5
370	35.1	34.8	34.4	34.0	33.7	33.3	33.0	32.6	32.3	31.9
360	38.9	38.5	38.1	37.7	37.4	37.0	36.6	36.2	35.9	35.5
350	42.9	42.5	42.0	41.6	41.2	40.8	40.4	40.1	39.7	39.3
340	47.1	46.6	46.2	45.8	45.3	44.9	44.5	44.1	43.7	43.3
	0	1	2	3	4	5	6	7	8	9

Figure 7 – Moisture Chart. Used to find the percentage of moisture content when the original wet weight of the sample is 500 grams. Use of this chart eliminates the calculations of Step 7 of example shown on preceding page.

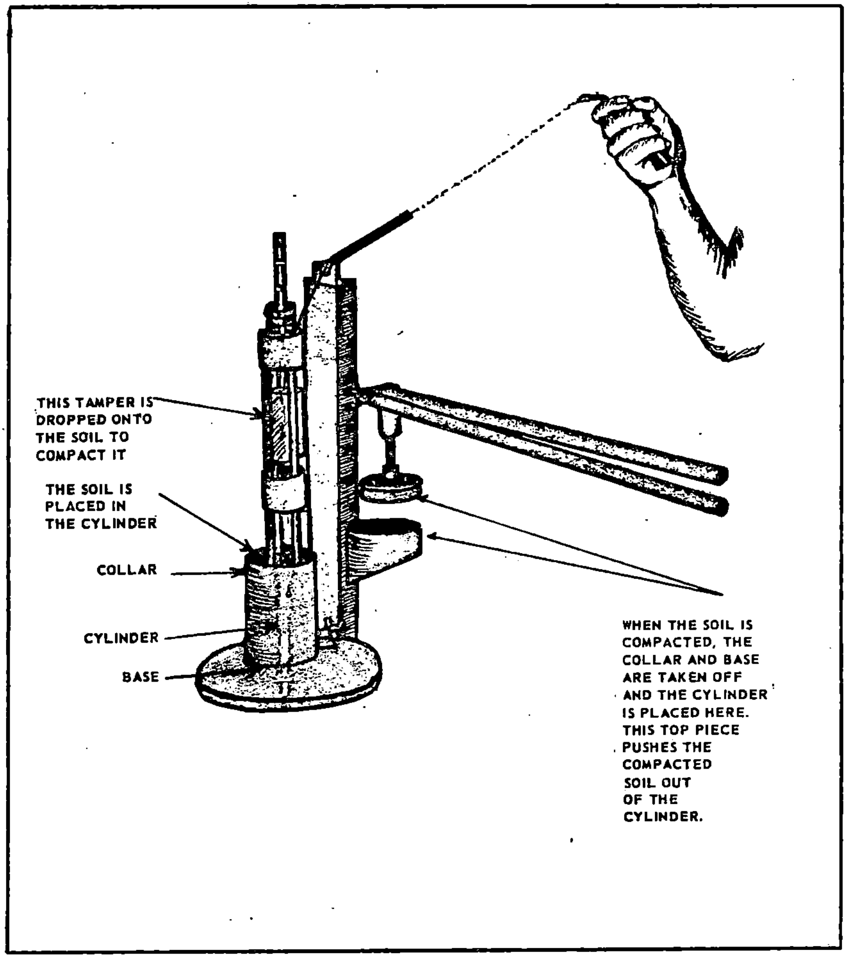

Figure 8 – Standard Proctor, Assembled

Oil Test for the Field Determination of Density of Soil In Place

SCOPE:

This test is intended to determine the density of a base, subbase, or subgrade by obtaining the dry weight of a disturbed sample, and measuring its volume by the oil density test.

APPARATUS:

1) Depth gage tripod.
2) 12 inch screwdriver.
3) Large square pan with 3½ inch hole.
4) Oil bottles and spouts (1 quart glass).
5) Density oil with specific gravity table.
6) Hole-cleaning spoon.
7) Thermometer (–30 to 120 degrees F).
8) Balance (O'Haus or Sargent), sensitive to 0.5 gr.
9) Hot plate or gasoline stove.
10) Oil Gun.
11) Pails with lids (½ gallon).
12) Drying pans.

TEST PROCEDURE:

Digging the hole in area to be tested:

1) Select a spot which appears representative of the test area. Remove all loose material and level a surface about 18 inches square. Place the center-level tripod on this spot, and drive three roofing nails into the surface of the material to serve as reference points.
2) Set the leveling device on these points, and adjust the center point to the elevation of the surface of the spot where the hole will be made.

3) Set this leveling device aside carefully, and dig a hole approximately four inches in diameter and the depth of the material. Be careful to retain all of the particles removed from the hole. Place them in a covered half-gallon pail.
4) In digging the hole, work from the center out and be careful to avoid disturbing soil or aggregate material bounding the hole. Granular material requires extreme care. Hammers and chisels are unsuited for this precise work, and should never be used. Loosening the material with a screwdriver and removing it with a spoon is the accepted procedure.

VOLUME DETERMINATION OF HOLE:

Set the leveling device back on the original points. Pour oil from the weighed container into the hole until the surface of the oil makes contact with the center point of the leveling device.

1) Record the temperature of the oil.
2) Compute the amount of oil poured into the hole by weighing the oil container and determining the loss in weight.
3) Determine the volume of the hole by dividing the weight of oil required to fill the hole using the grams-per-cubic-centimeter relationship of oil at the temperature used.

CALCULATIONS:

1) The dry weight in grams of the material removed from the hole divided by the volume of the hole in cc's gives the

specific gravity of the material.

2) This figure multiplied by 62.4 gives the weight of material in pounds per cubic foot. See enclosed chart to convert density directly to lbs. per cubic foot.

PRECAUTIONS AND SUGGESTIONS:

1) Remove the clean oil from the hole with the oil gun or syringe and return it to the can. Fill the hole with proper material, compact it thoroughly and leave the surface in an acceptable condition.
2) It is very useful to center a square pan (approximately 18" x 18") with a 3½" hole in the middle around the area to be sampled when loosening and removing material from the hole. This prevents accidental loss of material.
3) If the hole is larger than one quart, a second container can be used and the amount of oil required to fill the hole determined. However, no time delay can be tolerated.
4) Pouring the oil should be done as rapidly as possible with a consistently accurate stop; this prevents absorption of the oil by the surrounding material while pouring is in progress.
5) In porous or highly absorptive materials, this test may not be suitable for the given in No. 4. Sand cone or balloon volume determinations may be advisable.
6) Pour the oil along the side of the hole to eliminate as many air bubbles as possible.

Example of Field Density. The following data should be recorded for determination of field density:

Date __________ Project No. __________ County __________________

Party Members __________ Weather ______________________.

Hole No.	1	2	3	
Station No.	5+50	5+00	4+00	
Distance from C_L	9'R+	9'-L+	C_L	
Depth of Base	6"	5-3/4	6-1/4	
Can No.	1	2	3	
1. Weight of Sample	1686	1702	1648	Grams Weighed
2. Dry Wt. of Sample	1592	1604	1550	Grams Weighed
3. Loss in Moisture	94	98	98	Grams, Line 1-2
4. % Moisture	5.9	6.1	6.3	Line (3÷2) x 100

Oil Bottle	1	2	3	
5. Wt. of Bottle Full	1205	1224	1197	Grams Weighed
6. Wt. of Bottle After	515	549	555	Grams Weighed
7. Wt. of Oil Used	690	675	642	Grams, Line 5-6
8. Temp. of Oil °F.	72	74	76	By Thermometer
9. Sp. Gr. at Temp.	.9119	.9112	.9105	From Tables
10. Corrected Volume	757	741	705	Line 7 ÷ 9
11. Dry Density of Hole	2.10	2.165	2.20	Line 2 ÷ 10
12. Wt. Cu. Ft.	131.0	135.1	137.1	Line 11 x 62.4
13. % of Proctor Density	98.0	100.8	102.4	Line 12÷Proctor Density
14. % of Optimum Moisture	72.0	74.5	76.8	Line 4÷Optimum Moisture

Figure 9 – Data for Determination of Field Density

1.00 - 62	1.25 - 78	1.50 -	1.75 - 109	2.00 -
1.01 - 63	1.26 -	1.51 - 94	1.76 -	2.01 - 125
1.02 -	1.27 - 79	1.52 - 95	1.77 - 110	2.02 - 126
1.03 - 64	1.28 - 80	1.53 -	1.78 - 111	2.03 -
1.04 - 65	1.29 -	1.54 - 96	1.79 -	2.04 - 127
1.05 -	1.30 - 81	1.55 -	1.80 - 112	2.05 - 128
1.06 - 66	1.31 -	1.56 - 97	1.81 - 113	2.06 -
1.07 -	1.32 - 82	1.57 - 98	1.82 -	2.07 - 129
1.08 - 67	1.33 - 83	1.58 -	1.83 - 114	2.08 -
1.09 - 68	1.34 -	1.59 - 99	1.84 -	2.09 - 130
1.10 -	1.35 - 84	1.60 - 100	1.85 - 115	2.10 - 131
1.11 - 69	1.36 - 85	1.61 -	1.86 - 116	2.11 -
1.12 - 70	1.37 -	1.62 - 101	1.87 -	2.12 - 132
1.13 -	1.38 - 86	1.63 -	1.88 - 117	2.13 - 133
1.14 - 71	1.39 -	1.64 - 102	1.89 - 118	2.14 -
1.15 -	1.40 - 87	1.65 - 103	1.90 -	2.15 - 134
1.16 - 72	1.41 - 88	1.66 -	1.91 - 119	2.16 -
1.17 - 73	1.42 -	1.67 - 104	1.92 -	2.17 - 135
1.18 -	1.43 - 89	1.68 - 105	1.93 - 120	2.18 - 136
1.19 - 74	1.44 - 90	1.69	1.94 - 121	2.19 -
1.20 - 75	1.45 -	1.70 - 106	1.95 -	2.20 - 137
1.21 -	1.46 - 91	1.71 -	1.96 - 122	2.21 - 138
1.22 - 76	1.47 -	1.72 - 107	1.97 - 123	2.22 -
1.23 -	1.48 - 92	1.73 - 108	1.98 -	2.23 - 139
1.24 - 77	1.49 - 93	1.74 -	1.99 - 124	2.24 - 140

Figure 10 – Density Table, Pounds per Cubic Foot

The Density Table converts the dry density of the hole to weight-per-cubic-foot. Use of the table eliminates the calculation of Step 12 of the example on the preceding page.

Sand Cone Test for Soil Density

This test determines the density of a compacted base, subbase, or subgrade by finding the weight and moisture content of a disturbed sample and measuring the volume occupied by the sample (prior to removal). Volume is determined through use of a sand cone.

APPARATUS:

1) The same sampling tools and equipment used in digging the hole, and the same equipment used for determining moisture content in the oil density method.
2) Sand. Any clean, dry, free-flowing sand with a gradation between the No. 10 and No. 200 sieve.
3) Balance, with a capacity of 5 kg., accur-

ate to ½ gram.

4) One-gallon jar, with a sand cone apparatus, a means of attaching it to the jar, and a valve shut off.
5) Glass plate large enough to cover the large end of the cone.

PROCEDURE:

Sand Calibration:

1) Find the combined weight of the empty jar, the sand cone (with the valve gate closed and tightly sealed), and a glass plate; record to 0.5 gram.
2) Attach the sand cone to the jar, fill with water, and slide the glass plate across the surface to ensure that it is level full.
3) Record the combined weight of the jar, the sand cone, the glass plate, and the amount of water to fill the cone.
4) The difference between the weights obtained in Step 1 and Step 3 is the weight of water in the cone. In the gravimetric system, it is also the volume of cone in cubic centimeters. Check this volume by repeating the above procedure.
5) Next, weigh and record the combined weight of the sand cone and the jar filled not more than 2/3 full of sand. With the valve closed, invert the sand cone and place it on a smooth, level surface (a glass surface is satisfactory). Open the valve and let the sand flow into the cone until it comes to a stop. Close the valve

carefully. In no case should the cone or the surrounding area be disturbed or vibrated during this operation. Remove sand cone, record the combined weight of cone, jar, and remaining sand. Determine the weight of sand in the cone.

6) Repeat this procedure three times; average the results and record. If any of the three individual results look suspiciously incorrect, discard that result and repeat the procedure. Sand used in these determinations may be re-used without screening if kept clean.

CALCULATIONS:

With the volume of the cone determined, and the weight of an equal volume of sand obtained, the specific gravity of the sand is readily computed:

$$\frac{\text{Weight of sand (grams)*}}{\text{Volume of cone (cc)}}$$

*in the cone.

DENSITY DETERMINATION:

1) The hole is dug, and the moisture content of material removed is determined using the same procedure described for the oil density method.
2) Refill the sand cone jar with sand, weigh, and record the combined weight of sand cone jar and sand (W_A)
3) With the valve closed, invert the sand cone, centering it directly over the hole dug for the density determination.
4) Open the valve. Let sand flow to a stop, completely filling the hole and the cone. It is important that no vibration or disturb-

ance be permitted during this flow and during the stop.

5) Shut the valve carefully, remove the sand cone, and record the combined weight of cone, jar, and remaining sand (W_B).
6) The difference between W_A and W_B represents the total weight (W_C) of sand in the hole and sand in the cone.
7) Subtract the weight of the sand in the cone as previously determined from W_C to obtain the weight W_D of sand in the hole.
8) This weight (W_D) divided by the specific gravity of the sand previously calibrated equals the volume of the hole in cubic centimeters.
9) The field density determination is completed when the dry weight of the material removed from the hole is divided by the volume of the hole.

PRECAUTIONS:

1) Do not change source, moisture, particle size, or any other characteristics of the sand without recalibration. If sand is reused and becomes dirty, it must be rescreened or discarded.
2) Check the valve in the sand cone for proper working condition.
3) Instead of subtracting the weight of the sand in the cone, as determined in the sand calibration, it is desirable to use the weight of sand necessary to fill the cone when it is placed directly on the surface of the material to be checked for density for the deduction from W_C (in Step 6 above).
4) To do so, level and carefully clean a 12" x 12" area. Avoid leaving any loose dirt on the surface. If the sand cone does not appear stable or level, leaking of sand between the cone and the ground might result. Remove it and prepare another area.

5) Mark the exact position on the ground so that the cone can be replaced in the exact position later on. After determining the weight necessary to fill the cone in this manner (which will generally be greater than that obtained on a smooth surface), remove the sand, prepare the surface as before, and dig the hole.
6) Specific gravity of the sand is always determined by using the cone on a smooth surface.
7) At a temperature of 48 to 50 degrees F., the volume of one cc. of water almost equals one gram. As the temperature increases, the error increases.

Frequency of Proctor Determinations:

1) not less than one per each 3-mile section.
2) not less than two determinations for each project.

Frequency of Density Tests:

1) a minimum of three per mile for each layer.
2) the information must be recorded in the field book.

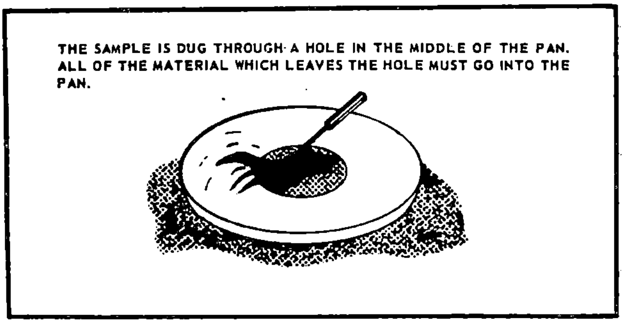

Figure 11 – Sampling for Density Tests

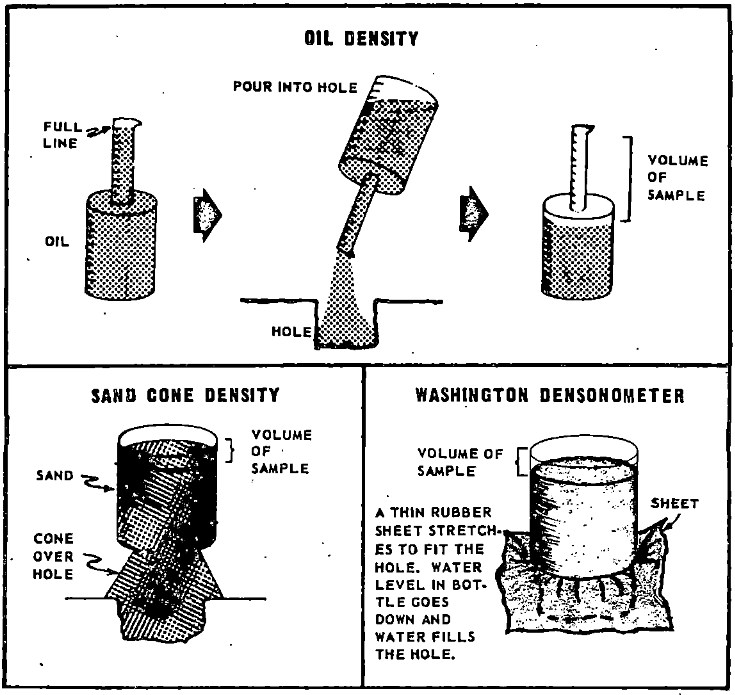

Figure 12 — Density Tests

CHECKING GRADES

County Highways

A line of stakes used only for alignment is usually set at a convenient distance from the centerline of the highway. This location normally falls on the foreslope or another area undisturbed by construction operations. The cross section is checked with an accurate template extending at least half way across the width of the subgrade or subbase. Deviations in excess of specifications must be corrected. The roadbed profile must be corrected to remove dips and humps. When correction is completed, it should have a good riding surface.

Primary Highways

Inspectors should check the finished surface of the roadbed, subbase, and most bases at each grade stake to ensure that construction has been done within the allowable variance. It is recommended that records be kept in a field book for each of the above surfaces, showing the deviation of the surface from the intended grade at each stake. These deviations should be recorded to the nearest .01 foot.

The cut of fill indicated at the grade stakes should show the elevation of the corrected roadbed. It should be unnecessary to change cut or fill markings at the grade stakes for construction of the subbase or base. The contractor is expected to construct the subbase and base in a manner that utilizes all material. The finishing profile should parallel the grades indicated by the stakes.

Subgrade settlement during compaction of subbase and base layers, and small variations in densities and spread quantities usually necessitate making grade adjustments during construction. Grade adjustments should be parallel, which means raising or lowering the grade uniformly for sections not less than 500 feet long. A rate of 0.10 per 100′ is used for transition into grade changes.

Grade adjustments should not be used to compensate for poor workmanship. The contractor should understand that the deviation from grade with the highest elevation for sections not less than 500 feet long may not vary by more than 0.10 foot from the deviation from grade with the lowest elevation in that section.

Checking Subbases and Recording Findings

To ensure that uniform methods are used throughout the state, the surfaces of roadbed, subbase, and base are checked with a stringline as shown in the following drawings:

1) minus (–) indicates low grade
2) plus (+) indicates high grade

There are two commonly used methods of recording data on grades:

1) A stringline is stretched from grade stake at the proper elevation. The inspector

measures from the stringline to the surface of the subbase, and records the difference between actual and desired readings:

desired reading	1.00 ft.
actual reading	0.98 ft.
figure to be recorded	– 0.02 ft.

2) An allowable range complying with specifications is established. If specifications allow a deviation of – 0.05 ft. from the established grade, the inspector measures from the string and records in the following manner:

desired reading	1.00 ft.
established allowable range	0.95 ft.
actual reading	0.98 ft.
figure to be recorded	0.98 ft.

	Deviation from Grade			Adjusted	Deviation from Adjusted Grade		
Station	Left	CL	Right	Grade	Left	CL	Right
+50	-50	-02	+02		-30	00	+04
PT +39.1	-02	-05	-01	L	00	-03	+01
+25	-02	-03	+03	O	00	-01	+05
102+00	-04	-05	-04	W	-02	-03	-02
+75	-07	-07	-02	G E	-05	-05	00
+50	-06	-04	-06	R R	-04	-02	-04
+25	-04	-02	-01	A	-02	00	+01
101+00	-03	00	+02	D	-01	+02	+04
+75	+02	+03	+01	E	+04	+05	+03
+50	+03	+02	+02	.02	+05	+05	+04
+25	+01	+03	+02		+03	+05	+02
100+00	+02	+03	00		+04	+05	+02

Minimum section for changing grade 500 feet

Figure 13 – Inspector's records of deviations from staked grade for the subbase, with a parallel adjustment in grade of 0.02 foot. Similar records are kept for roadbed and base.

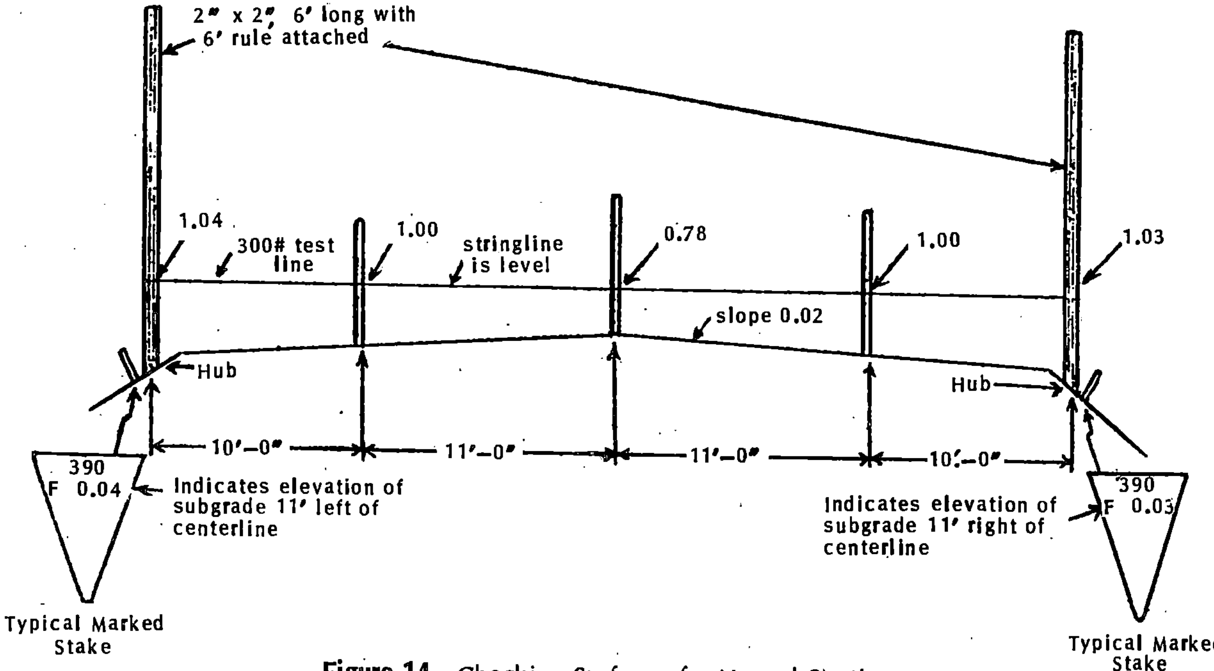

Figure 14 –Checking Surface of a Normal Section

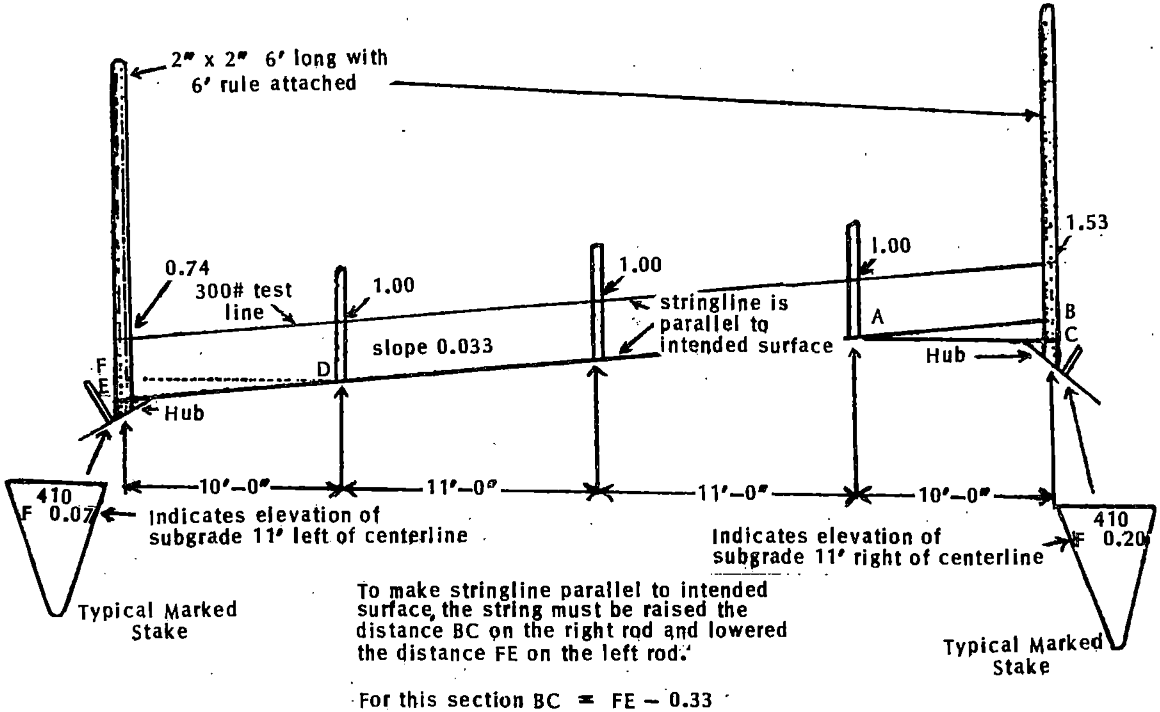

Figure 15 – Checking Surface of a Superelevated Section

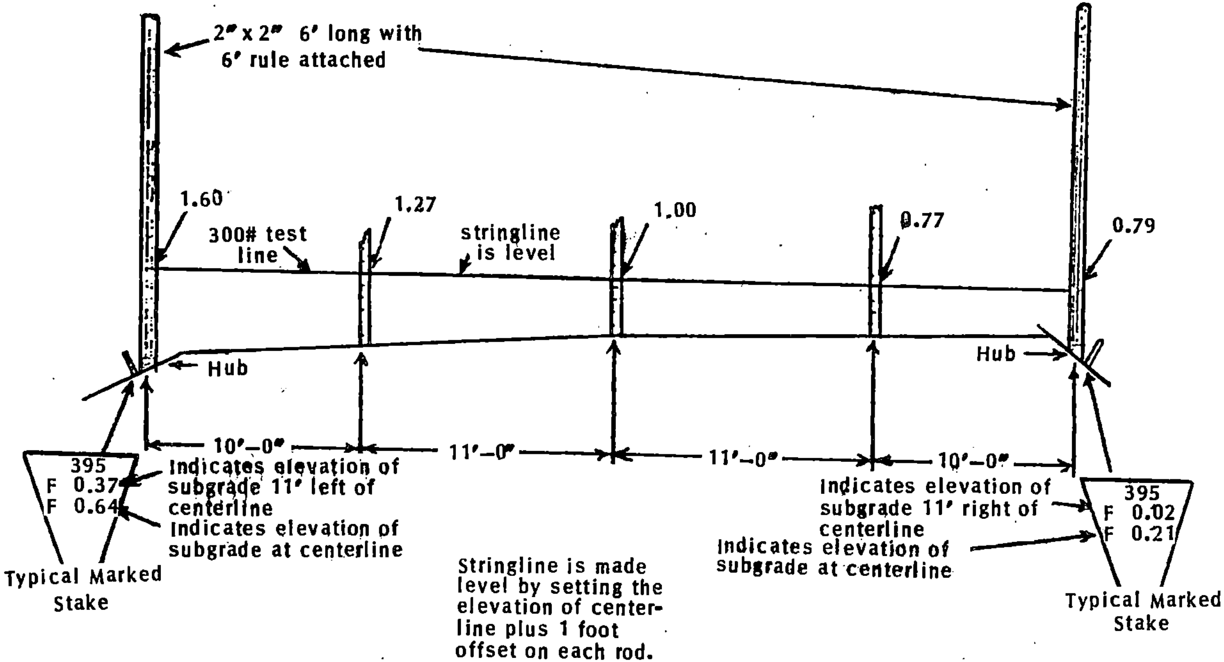

Figure 16 – Checking Surface of a Transition Section

THICKNESS AND WIDTH

Three thickness and width determinations per lift for each mile should be recorded in the field book.

SEALING AND PRIMING

After it has been constructed to the line, grade, density, and moisture requirements, and, if priming or sealing is designated in the plans, the subbase should be primed or sealed at the rate specified.

Subbases are classified in two categories:

1) penetrating subbases – such as soil aggregate or granular. The primer bitumen must be applied when the road surface is dry and warm enough to obtain proper penetration.
2) non-penetrating (sealing) subbases– such as soil lime or soil cement. Wetting is necessary until sealer bitumen is applied. The surface should be dense and free of loose foreign material, and should contain enough moisture to prevent penetration of the bituminous material. No sealer should be applied when free water is visible on the surface.

Before any bitumen is spread on the road, the inspector should determine the amount and temperature of the bitumen in the distributor. When the designated area of the road has been covered with bitumen, the inspector should again determine the amount and temperature in the distributor. The bitumen quantity must be corrected to 60 degrees F. volume, using a correction table. The data should be recorded in the field book.

GROUP 1—SPECIFIC GRAVITY AT 60°F OF 0.850 TO 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
0	1.0241	50	1.0040	100	0.9842	150	0.9647	200	0.9456
1	1.0237	51	1.0036	101	0.9838	151	0.9643	201	0.9452
2	1.0233	52	1.0032	102	0.9834	152	0.9639	202	0.9448
3	1.0229	53	1.0028	103	0.9830	153	0.9635	203	0.9444
4	1.0225	54	1.0024	104	0.9826	154	0.9632	204	0.9441
5	1.0221	55	1.0020	105	0.9822	155	0.9628	205	0.9437
6	1.0217	56	1.0016	106	0.9818	156	0.9624	206	0.9433
7	1.0213	57	1.0012	107	0.9814	157	0.9620	207	0.9429
8	1.0209	58	1.0008	108	0.9810	158	0.9616	208	0.9425
9	1.0205	59	1.0004	109	0.9806	159	0.9612	209	0.9422
10	1.0201	60	1.0000	110	0.9803	160	0.9609	210	0.9418
11	1.0197	61	0.9996	111	0.9799	161	0.9605	211	0.9414
12	1.0193	62	0.9992	112	0.9795	162	0.9601	212	0.9410
13	1.0189	63	0.9988	113	0.9791	163	0.9597	213	0.9407
14	1.0185	64	0.9984	114	0.9787	164	0.9593	214	0.9403
15	1.0181	65	0.9980	115	0.9783	165	0.9589	215	0.9399
16	1.0177	66	0.9976	116	0.9779	166	0.9585	216	0.9395
17	1.0173	67	0.9972	117	0.9775	167	0.9582	217	0.9391
18	1.0168	68	0.9968	118	0.9771	168	0.9578	218	0.9388
19	1.0164	69	0.9964	119	0.9767	169	0.9574	219	0.9384
20	1.0160	70	0.9960	120	0.9763	170	0.9570	220	0.9380
21	1.0156	71	0.9956	121	0.9760	171	0.9566	221	0.9376
22	1.0152	72	0.9952	122	0.9756	172	0.9562	222	0.9373
23	1.0148	73	0.9948	123	0.9752	173	0.9559	223	0.9369
24	1.0144	74	0.9944	124	0.9748	174	0.9555	224	0.9365
25	1.0140	75	0.9940	125	0.9744	175	0.9551	225	0.9361
26	1.0136	76	0.9936	126	0.9740	176	0.9547	226	0.9358
27	1.0132	77	0.9932	127	0.9736	177	0.9543	227	0.9354
28	1.0128	78	0.9929	128	0.9732	178	0.9539	228	0.9350
29	1.0124	79	0.9925	129	0.9728	179	0.9536	229	0.9346
30	1.0120	80	0.9921	130	0.9725	180	0.9532	230	0.9343
31	1.0116	81	0.9917	131	0.9721	181	0.9528	231	0.9339
32	1.0112	82	0.9913	132	0.9717	182	0.9524	232	0.9335
33	1.0108	83	0.9909	133	0.9713	183	0.9520	233	0.9331
34	1.0104	84	0.9905	134	0.9709	184	0.9517	234	0.9328
35	1.0100	85	0.9901	135	0.9705	185	0.9513	235	0.9324
36	1.0096	86	0.9897	136	0.9701	186	0.9509	236	0.9320
37	1.0092	87	0.9893	137	0.9697	187	0.9505	237	0.9316
38	1.0088	88	0.9889	138	0.9693	188	0.9501	238	0.9313
39	1.0084	89	0.9885	139	0.9690	189	0.9498	239	0.9309
40	1.0080	90	0.9881	140	0.9686	190	0.9494	240	0.9305
41	1.0076	91	0.9877	141	0.9682	191	0.9490	241	0.9301
42	1.0072	92	0.9873	142	0.9678	192	0.9486	242	0.9298
43	1.0068	93	0.9869	143	0.9674	193	0.9482	243	0.9294
44	1.0064	94	0.9865	144	0.9670	194	0.9478	244	0.9290
45	1.0060	95	0.9861	145	0.9666	195	0.9475	245	0.9286
46	1.0056	96	0.9857	146	0.9662	196	0.9471	246	0.9283
47	1.0052	97	0.9854	147	0.9659	197	0.9467	247	0.9279
48	1.0048	98	0.9850	148	0.9655	198	0.9463	248	0.9275
49	1.0044	99	0.9846	149	0.9651	199	0.9460	249	0.9272

Figure 17 – Specific Gravities

Priming Subbase

Priming requires a satisfactorily-operating, calibrated distributor. Spray bar nozzles should be set at the manufacturer's recommended angle and height above the road. Correct spray pressure for the size nozzle used should be maintained. Trying the bar before shooting prime is good practice; it makes sure that all nozzles are open and functioning perfectly. Prime should be heated to the upper range of temperature limits indicated by standard specifications. The first shot should be short, and the rate of application checked so any necessary corrections can be made on the manufacturer's application charts. The base surface temperature should be checked and within specifications before any priming is done.

Base Surface Temperature

Liquid bitumens cannot be placed when a shaded portion of the road surface is cooler than the specified temperature. For uniformity, the following method of checking temperatures of shaded areas must be used on all projects:

1) Select a representative portion of the road surface to be covered with the liquid bitumen. If all the surface is subjected to direct sunlight, the test location should be in the sunlight. If portions of the road are shaded, the test location should be in the shade.
2) Lay the thermometer directly on the road surface in the test location. Shade the area temporarily while taking the temperature. The inspector should stand with his shadow covering the thermometer. The thermometer should remain in the test location for five minutes. Temperature tests should be made as often as necessary to certify that work is done according to specifications.

REPORTS AND RECORDS

Required Reports

Form 387A, Density Report – Copies should be sent to the Ames Office, the District Office, the Resident Construction Engineer, and/or the County Engineer.

Form 193, Sample Identification – to be used for any and all samples sent to Ames Lab.

Weekly Postcards

The three types of cards previously used have been combined into a single postcard. It covers these phases of construction:

1) AC or PCC Pavement
2) Asphaltic Concrete Resurfacing
3) Grading

Cards should be sent on only those primary or interstate projects which fit the above classifications. They should be mailed on Friday night or Saturday to arrive at the central office the following Monday.

When a project has been suspended, it should be so noted on the card, giving the date of suspension. Cards need not be sent until work on the project has been resumed. Also, when a project has been completed, the final card should contain the date of completion.

New cards are available at the central construction office in Ames, but all old cards should be used up before new ones are ordered.

Forms Optional for Local Use

Form 53, Daily Report of Materials Used on Construction of Interstate Pavement, Base, and Shoulders, is intended for use on all flexible base and asphalt base or surface projects – including primary and secondary. The report may be prepared by the inspector on each project as information for the resident construction engineer or the county engineer to use in the preparation of estimates.

FORM 387A REV.

IOWA STATE HIGHWAY COMMISSION

Construction Department

DAILY REPORT – BASES & MOISTURE DENSITY EMBANKMENTS

Primary or Secondary Roads

County ______________________

Project ______________________

Date ______________________

Report No. ______________________

Res./Co. Engr. ______________________

Contractor ______________________ Miles in Project ______________________

Plan Thickness	Type	Section Worked Sta. to Sta.	Distance Test hole from CL	Proctor or A. C. Lab. Density	Field Density	% Proct. or A. C. Lab. Density	Proctor Moisture	Measured Depth	* Percent Moisture	Parts Res. or % A. C.	Course Laid	Total Miles Completed

REMARKS: ______________________

*Bases – % moisture at time of density test.
Grading – % moisture before compaction.

Signed: ______________________
Inspector

Figure 18 – Form 387A

FORM 193

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
Ames, Iowa

IDENTIFICATION OF SAMPLE FOR TEST

(Read instructions on back before taking sample and filling out form)

Material__________ Sender's Sample No.__________

Intended Use__________

County__________ Project__________ Road No.__________

Contractor__________
(Name) (Address)

Producer__________ Brand __________

Location of Producing Plant__________

__________Sec.__________Twp.__________Range__________Co.__________

Unit of Material Represented __________

____

__________Quantity Represented__________

Sampled by__________
(Name) (Address)

Date Sampled__________ Sample Shipped by (Frt.) (P.P.) (Express)

Report to__________
(Name) (Title) (Address)

Report to__________
(Name) (Title) (Address)

Report to__________
(Name) (Title) (Address)

Additional Detailed Information:
(For paint give analysis printed on container. For tile give grade specified, etc.)

____

____

____

____

____

____

____

____

____

____

(NOTE: A representative of the State Highway Commission shall select the sample.)

Figure 19 – Form 193

WEEKLY REPORT
AC OR PCC PAVEMENT
RESURFACING
OR INTERSTATE GRADING

AC_____PC_____GRADING____
(check one)

Work done incl. Friday__________
(date)
Contractor____________________
Project_______________________
County________________________

Fill in appropriate blank:
Subgrade______% Subbase______%
Base__________% Binder_______%
Surface_______% PC Slab______%
Shoulders______%
Grading________%
Total Contract Completed______%
Remarks:________________________

Signed________________________
Title_________________________

Figure 20 — Weekly Postcard

Form 53

DAILY REPORT OF MATERIALS USED ON CONSTRUCTION OF INTERSTATE PAVEMENT BASE AND SHOULDERS

IOWA STATE HIGHWAY COMMISSION

CONSTRUCTION DEPARTMENT

Report No. ____________

Contractor ______________________________ Project ______________________________

County ______________________________ Date ______________________________

GRANULAR SUBBASE

Material								
From								
To								
Depth								
Width								
Lane								
Div.								
Tons								

Tons ____________ Previous Total ____________ Total to Date ____________

BASE AND SHOULDER BASE

Material								
From								
To								
Depth								
Width								
Lane								
Div.								
Tons								

Shoulder Base ____________ Previous Total ____________ Total to Date ____________
Base ____________ Previous Total ____________ Total to Date ____________

BITUMINOUS PRIMER, BINDER AND FOG COAT

Use								
Place								
Material								
From								
To								
Lane								
Div.								
Gal.								

Primer ____________ Previous Total ____________ Total to Date ____________
Binder ____________ Previous Total ____________ Total to Date ____________
Fog ____________ Previous Total ____________ Total to Date ____________

COVER AGGREGATE

Material								
From								
To								
Lane								
Div.								
Tons								

Tons ____________ Previous Total ____________ Total to Date ____________

ASPHALTIC CONCRETE

Use								
From								
To								
Lane								
Div.								
Tons								

Binder ____________ Previous Total ____________ Total to Date ____________
Surface ____________ Previous Total ____________ Total to Date ____________
Shoulder ____________ Previous Total ____________ Total to Date ____________
Cut Samples ____________ Previous Total ____________ Total to Date ____________

Remarks ____

Totals checked ____

Contractor Inspector

Figure 21 — Form 53

6-6-69 Monday cloudy-cool high 70 low 60

Start 6:00 A. M.

Stop 5: 00 P. M.

Visitors today - Res. Engr. Jackson A.M.
Chief insp. Smith P.M.

Daily Project Information

Include all delays, shutdowns, type of work,
area of work, progress, problems and solutions.

Insp. Signature or initials

Figure 22 — Diary

Proctors

Date Station						
Wet Wt. spec.						
Pan No, Wet Wt pan And Sample						
Wt of Pan						
Dry Wt. Sample						
Moisr Loss						
% Moist.						
Calc. Dry Wt.						
Dry Wt. Lbs.Cu.Ft.						
Proctor Density						
Proctor Moist.						
Inspectop						

Cut Here

NOTE:

First page will contain the headings for the record information along the left column. The headings would not have to be repeated on suceeding pages if the left column was cut off of the suceeding pages. The heading from the first page would be used for the other pages.

Figure 23 — Diary

Oil Density Tests

Date						
Weather						
Hole No.						
From Sta.						
To Sta.						
Sta. No.						
℄ Dist.						
Depth						
Can no.						
Wet Wt. Sample						
Dry Wt. Sample						
Loss						
% Moist.						
Wt. Bottle Start						
Wt. Bottle Stop						
Wt. Oil Used						
Temp. Oil						
Corr. Fact.						
Corr. Vol.						
Dry Den. Dry Wt. Cu. Ft.						
Proc. Opt. Moist.						
Proc. Den.						
% Proc.						
Pass						
Inspector						

Cut Here

NOTE:

First page will contain the headings for the record information along the left column. The headings would not have to be repeated on suceeding pages if the left column was cut off of the suceeding pages. The heading from the first page would be used for the other pages.

Figure 24 – Diary

Construction of Subbase

Date	Station From	Station To	Date Laid	Density Pass	Grade Pass	Date Completed	Inspector	Remarks
6-6-69	27+50	51+40	6-7-69	6-8-69	6-10-69	6-11-69	JLR	

Material for Subbase

Date	Station From	Station To	Length	Tons Req'd	Tons Used	%	Tons To Date	Insp.	Remarks
6-6-69	27+50	51+40	2390	717.0	722.4	100.8	722.4	JLR	

Prime Record

Date	Time	Station From	Station To	Lineal Feet	Width	Sq. Yds	Distributor Start	Distributor Stop	Gals. Used	Temp	Corr. Fact.	Gal @ 60°	Rate	Insp.
6-12-69	1:00	27+50	51+40	2390	24.0	6373	2000	22	1978	230	.9343	1848	.29	JLR

Figure 25 — Diary

NOTES